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THE SWEDISH ANTARCTIC EXPEDITION, 1902-03.

This expedition, led by Dr. Otto Nordenskjöld, has returned after unusual vicissitudes. It will be remembered that Nordenskjöld and five companions were left on Feb. 21, 1902, by their steamer, the *Antarctic*, on an island near the coast of Louis Philippe Land, not far from Seymour Island. A year later the *Antarctic*, returning south to meet the explorers and take them home, was crushed in the ice and sank about sixty miles from Nordenskjöld's camp. Three men from the *Antarctic* had previously landed on the coast; the other members of her crew reached Paulet Island with great difficulty after the sinking of their vessel. Neither party knew where the other was spending the winter, and Nordenskjöld did not know that the *Antarctic* was at the bottom of the sea and that his countrymen were in two camps to the north of him. All three parties have been rescued by the Argentine vessel *Uruguay*.

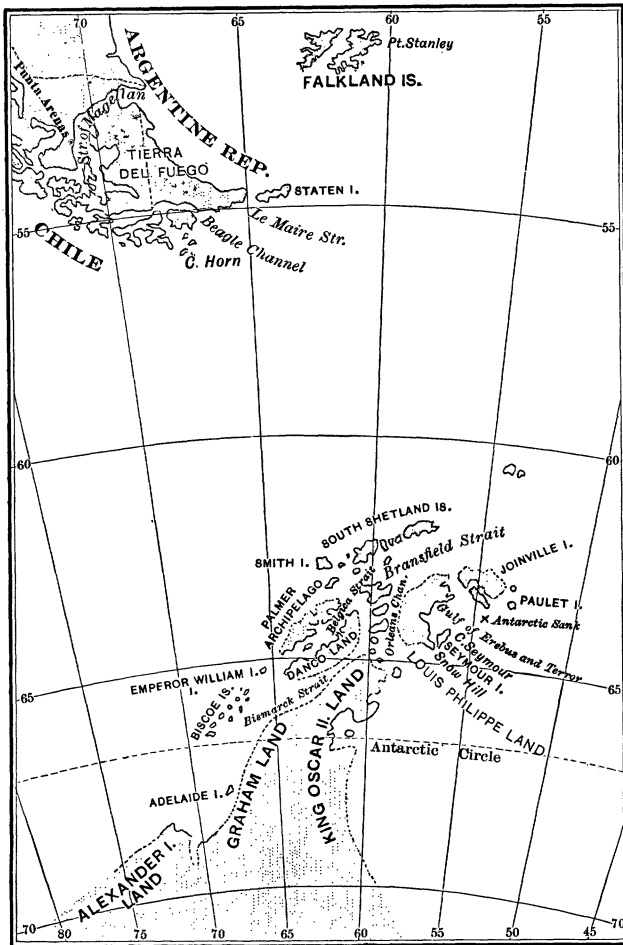
Dr. Nordenskjöld relates (London *Times*, Dec. 30, 1903) the adventures of his party and of the men of the *Antarctic* from the time he was left at his camp till their rescue. The following facts are taken from his narrative; and the accompanying map shows the region to the south of South America in which he spent two winters.

In the last days of February and the first weeks in March, 1902, the six men were busy constructing their houses and observatories. After starting the scientific observations attempts were made to begin sledge-work and plant supply caches further south. These efforts were defeated by persistent winds of hurricane force and low temperature. The party, accordingly, settled down to the winter routine in camp. Dr. Nordenskjöld writes:

The meteorological observations were divided between Dr. Bodman and Lieutenant Sobral, though during the night watches the work was shared by the whole scientific staff. Dr. Ekelof was occupied with bacteriological investigations, and I myself used every opportunity to collect fossils and prepare the map of our surroundings.

No one had anticipated that we should be compelled to remain so much within doors. It is true that, from the reports of the *Belgica* and *Southern Cross* expeditions, it was well known that the winter in the Antarctic is both severe and stormy; but who could imagine that we in our station, situated six or seven degrees further from the Pole, should meet with a considerably lower temperature than the first of the above-mentioned expeditions, and almost as low as the second, and at the same time should experience gales that in persistence, if not in strength, far surpassed those

encountered by the expeditions referred to? But so it was. April was the best month during the winter, but with the beginning of May there commenced a period of storms which, with short intermissions, never exceeding three days, lasted five months, until the end of September. During the whole of this time the average velocity of the wind was 23 miles an hour, and once, during a whole fortnight in May and June, it averaged 45 miles.



MAP OF THE GRAHAM LAND REGION.

"It is difficult to give an idea of these terrible gales. Our house was continually shaking, like the cars in an express train. Everything not solidly fixed was carried away, and after every storm we had to look for lost things. A large whaleboat lying on the shore was carried off hundreds of yards and crushed against the rocks. But what made the wind specially objectionable was that these strong gales from the southwest brought with them the lowest temperatures that we experienced—a feature

in a measure peculiar to the region. Thus, during the period mentioned in June the thermometer varied between -25° and -32° C. (-13° and -26° F.), and our stormiest day (mean velocity 63 miles an hour) was also one of the coldest (mean -31° C., or -24° F.). At such temperatures it was absolutely impossible to stand up against a wind of that force, and even in the daytime it became quite a difficulty to go as far as the observatories.

"So it came about that we had to pass a very long time indoors, more even, perhaps, than many expeditions wintering in the darkness of the night far nearer to the pole. Our house was small but pretty comfortable, with one large room 8 ft. by 14 ft. in the middle, and four smaller on the sides, one for the kitchen and three sleeping rooms for two men each. Over the whole house was a roomy loft, used as a store room. It was generally not difficult to keep the house warm, though we had hoped to get some snow to pile up round the walls, which, however, was never possible. Seal's blubber as fuel proved far superior to coal.

"I made during the winter several short sledge trips, though I was never absent for a long time. From the beginning of August, however, a good part of the time was occupied in preparations for a longer sledge trip southwards, which I had already contemplated before landing. We carried for the purpose a pretty good equipment of necessities, and it was only in one point that we were seriously handicapped—the number of dogs at our disposal. Of the dogs I brought from Greenland all except four died on the way out, those four, however, being exceedingly fine animals. A number of pups born on the ship were frozen to death in a gale a few days after our landing before we had been able to arrange for them. The dogs I brought from the Falkland Islands proved not altogether unsuited to our needs, but most of them, and first of all the strongest and most courageous, had soon been killed by their ferocious Greenland companions. So for the expedition I could only use in all five dogs, a quite insufficient number, remembering that it was impossible, by reason of the smallness of our company, for me to arrange so that an auxiliary party should follow us with fresh supplies.

"My companions on the trip were Lieutenant Sobral and the sailor Jonassen. I took two sledges, the one to be pulled by the dogs, the other by two of the men. We carried provisions for 45 days, but calculating that we should go on the sea-ice, and that our load was already rather heavy, I took only about 20 days' food for the dogs."

The start was made on September 30. The weather was fine for ten days, and then violent storms resumed their sway. Passing out of Admiralty Sound a large inlet was discovered extending northward from the broken line on the map, which indicated this unknown part of the south coast of Louis Philippe Land. The explorer believed this to be

a large channel opening into Erebus and Terror Gulf and separating an archipelago of islands from the mainland. This mainland, the hitherto unknown connexion between Louis Philippe Land and King Oscar Land, is formed by a high range of mountain peaks separated by large glaciers and further inland passing into a level ice-covered plateau.

The party were unable to get further south than lat. 66° , long. 62° W., a little more than 200 miles from the station. The ice was

very difficult; no seals were found for dog-food and Dr. Nordenskjöld was compelled to turn back while still two degrees of latitude north of the point on the coast of King Oscar II. Land reached by Larsen in 1893-94. He was back at the station on November 7 after an absence of about five weeks.

Some very interesting discoveries were made on Seymour Island, to which the explorer made a sledge trip about December 1:

It was during an excursion to the northern point of that island that I made in one day two important discoveries. On a ridge of hills I collected numerous fossil bones of vertebrate animals, some of them of great size, and a little further south I found a layer rich in plant remains belonging to numerous species. And so there seems to be no doubt that in those remote regions, where now the vegetation is as much inferior to that of Greenland or Spitzbergen as that is compared with an English forest, the climate was once mild, and that there existed then large forests of leaf-bearing trees where birds sang and strange large animals fed on the herbage. That this has been the case in the north has long been known, but it is the first time it has been proved in the south.

At no time during the summer was the sea open enough for the arrival of the *Antarctic*, and the party began to feel uneasy about their relief. It was decided to lay in a supply of fresh meat, as they should probably have to spend another winter in that region. On February 6 they started for the rookery on Seymour Island. "We killed," writes Dr. Nordenskjöld, "about 400 birds,

which proved fully sufficient for our winter. However, to our taste, seal meat is much better than penguins, and it is specially to be remarked that it is impossible to get, even from a great number of penguins, grease enough to serve as fuel during winter.

It was during those days that the ice-conditions were the best that summer. Much open water was seen in all directions on our east coast, and several times we imagined we saw the ship among the ice. But the winter was already setting in; strong gales, alternating with snow and snow fog, were blowing from all directions, sometimes with temperatures as low as -10° C. (14° F.); and a few days later, again nothing but ice was seen all round the horizon, and everybody was forced to acknowledge that we were going to pass another long winter in our old quarters. None of us knew that during those stormy days the *Antarctic* had fought her last fight with the ice.

From this time commenced for us the second winter. We had good stores of provisions brought from home, except meat, which, as already mentioned, was got from the game of the region. The only real difficulty was the isolation, which seemed the greater now that we had once considered the relief to be so near. But I never heard a complaint from any of my companions, and, in fact, our great consolation was that this second winter would give us far more ample opportunity to work for science than we could ever have expected. All the members did their best to find new ways to complete their researches.

Fortunately, this winter was far better than the former, not so much with regard to the temperature as to the gales, which were neither so strong nor so persistent as before. Here is a short summary of the scientific results obtained during the two years of wintering.

The principal object was the magnetic and meteorological observations. About the former nothing can here be recorded, the observations not yet having been worked out. An interesting though negative result was that in those two years we did not observe a single aurora australis. Of the meteorological results the most interesting is the unexpectedly cold climate of the region visited. The mean temperature for the first year was about -12° C. (10.2° F.), the same as in Hudson Strait or in Jakutsk, the two coldest places in the north, situated in more or less the same latitude as our station; at the same time it is several degrees lower than the temperature experienced by the Belgian expedition six degrees further south (14.7° F.). It is possible that this year was colder than usual, but as already stated the second winter was not very much warmer. What seems to be certain is that the summer was exceptionally cold; with a mean temperature of -2.2° C. (28.2° F.) it is the coldest known until now on the earth. In connection with this are to be considered the exceedingly bad ice conditions, that were so disastrous for us.

Interesting, too, are the great average velocity of the winds (the first year 20 miles an hour), their generally south-westerly direction, and the strength of the gales in the winter as compared with the summer.

As of geological interest, I have already mentioned the discovery of fossil plants and vertebrates, but besides this the island where the station was situated, as well as neighbouring islands, are very rich in fossils, all belonging to mesozoic or tertiary formations.

On September 29, 1903, Nordenskjöld started with sailor Jonassen and a sledge drawn by six dogs (two born at the station) to study the region north and northwest of the station. He turned into the great inlet discovered on the previous expedition. This channel afforded a view of the grandest scenery:

On one side was the magnificent range of King Oscar Land; on the other a large archipelago forming a remarkable contrast to the former and made up of tufaceous volcanic rocks, with sounds, glaciers, and promontories, all dominated by the shining blue-white prominent peak of Mount Haddington, probably formed by a mighty crater.

They advanced north till they had Erebus and Terror Gulf before them, and were travelling towards it when, on October 12, they saw far away some dark objects, which they at first thought were large penguins, but through the glass they discovered that two men were coming towards them. As they drew near, writes the explorer,

I saw two men, their faces coal-black, the eyes protected by rude wooden pieces; their black hair was hanging to the shoulders; their clothes were blackened and of an unknown shape. Even at the moment we met I had no idea who they were, and their first question—"Have you heard anything from the *Antarctic*?"—could not explain the situation.

It was Dr. Andersson, the leader of the expedition during my absence, and Lieutenant Duse, who, together with a sailor who was now preparing their dinner, had left the *Antarctic* at the end of December, the previous summer, when it became exceedingly dubious whether the ship could reach the station during that season. Their intention was to reach our station with a sledge. However, they soon found

that it was impossible at that time to reach the station owing to the state of the ice. So they turned back to a bay near Mount Bransfield, where a small depot had been put ashore and to which the *Antarctic* was to return. Here they passed the time agreed, waiting for the ship.

As months passed they began to grow anxious and prepare for winter, and in the beginning of March they moved into a small, low, stone hut. Here they passed seven long winter months. The construction of the hut was a difficult task, as the ground was frozen and they had no tools. They killed about 500 penguins for winter food, depending for fuel exclusively on seals. They had no books, and even if they had had they could not have read them by the feeble light of their blubber-lamp. The temperature inside was generally below freezing-point, and by reason of the gales they were for long periods confined to their berths composed of the bags and the few articles of clothing carried for the summer.

Notwithstanding this, their sojourn had not been without results. Mr. Duse had made a map of the surroundings, so that there is now, including the work of the *Antarctic* in the Orleans Channel, and my own work and that of Mr. Duse on our sledge-trips, a complete map of the whole coast from the southern end of the Gerlache Channel, on the west coast, to the turning-point of our first sledge expedition in latitude 66 deg., on the east. Dr. Andersson had found interesting proofs of the former greater extension of the glaciers, and what was more important, he had found a rich fossil flora of a very different type from that of Seymour Island and belonging to an older geological epoch. Now they were on their way to our winter station.

Andersson's sailor was picked up, and the five men made their way to Nordenskjöld's camp, much mystified over the fate of the *Antarctic*. The advancing summer, however, seemed very favourable for their relief if a vessel were sent for them. The ice was more open than at any time in the previous summer; and while the mean temperature for the latter half of October, 1902, was 0° F., it was in 1903, + 30°.

The Argentine relief steamer *Uruguay*, under Commander Irizar, finally arrived off this camp, and Nordenskjöld met her officers on Nov. 8 as he returned from Seymour Island with the first penguin eggs of the season. There was no news of the *Antarctic*, and the probability was now all too great that she had been lost with all on board.

But that very night the dogs set up a furious barking, and Dr. Bodman went outside the cabin to see what was disturbing them. A moment later he rushed back, shouting: "It is Larsen" (the Captain of the *Antarctic*). Larsen, with four men, had arrived on the very day that Nordenskjöld had first despaired of their safety. The story of the last voyage of the *Antarctic*, and of the fortunes of her men after she sank, was then told to eager listeners.

She left Tierra del Fuego on Nov. 6, 1902. West of the South Shetland Islands the party met heavy pack ice, through which they

pushed with difficulty. Reaching Bransfield Strait they found the region comparatively free of ice, and

here they worked for some time, obtaining a very interesting series of soundings as well as collections of animals and plants unexpectedly rich even compared with what we had seen the first summer. At the same time a chart was made of the Orleans Channel as far as where this passes into the Gerlache Channel.

This work having been finished, the intention was to proceed to the winter station, but now the difficulties really began. They soon found that the whole of Erebus Gulf was filled with ice, and when they tried to pass eastward of Joinville Island they were caught by the ice and drifted with this as far north as Elephant Island. Eventually, however, by dint of hard work, they got free of the ice and, trying again to find a way through the strait west of Joinville Island, they there passed Christmas, with the nearest land in sight, though at a distance of about 60 miles. It was now that Dr. Andersson and Mr. Duse decided to make the sledge trip, the result of which has above been related. During this time the *Antarctic* had to try her luck another time eastward of the land.

It was now late in the summer, and, though the ice conditions were clearly hopeless, there was nothing else to be done except to press on. Struggling hard, they passed round Joinville Island, during the first days of the new year, and through a narrow opening in the ice they could advance several miles to the south. But here they were again caught by the ice, and drifted north until, on January 10, a strong gale from the south commenced, filling the bay and setting the ice rapidly against the northern shore. The steamer was at that time fast in the ice about 20 miles south from Dundee Island. The storm keeping on, the ice began to press very heavily, lifting the ship about 4 feet. The situation was most perilous, and the disaster came with a big ice-floe, with strong pressure-ridges, rising high out of the water. From this ice emerged a large ice-foot which, catching the steamer from underneath, broke the rudder and the keel, bent the axle of the screw, and tore up the bottom of the ship, fixing the vessel at the same time solidly in its embrace.

Only after three weeks' hard work was it possible to release the steamer from the grasp of this ice-foot. The pumps were working all the time, and when the ship got free the leak proved too great to be managed with the resources on board. For another week the vessel drifted in the ice without finding a way out. Had it only been possible to bring the ship to the beach while still afloat the stores and provisions, as well as all our valuable collections, could have been saved. But even this proved impossible, and the same head gales in the beginning of February that raised our hopes in the station were disastrous for the ship. On February 12 the *Antarctic* was abandoned, and an hour later she was buried in the sea.

The question was now to bring the men and as many as possible of the most important things over the drifting pack-ice to the land selected for winter quarters, the small, volcanic island of Paulet, known to be rich in seals and penguins. This, under the admirable direction of Captain Larsen, was executed during the following sixteen days. Three boats were carried, used as sledges and pulled by the party, to take the outfit. The advance was very difficult, and many times in the morning the whole party found themselves carried away by the strong currents much further from their goal than before the whole work of the foregoing day. Gradually more and more of the things were lost, and at last, when they arrived at the open land at the foot of the island and had to put out the boats, only a small part could be saved. The travellers were barely on the shore when a storm broke out, carrying off the ice

and making it impossible to think of returning to bring on shore the part of the outfit left on the ice.

A stone hut was built, and in this the twenty men passed the winter, using for food the meat of seals and penguins that could be obtained, and also catching a good number of fish, which proved a very welcome change. What was most scarce was fuel, as the seals were by no means numerous during the winter. It was a hard life; but happily all were in good health, except the young Norwegian seaman Wenersgaard, who died of heart affection in the middle of the darkness and the gales of the winter on June 7. It had long been arranged that a small party should start for the winter station to bring us news of the fate of the *Antarctic* as soon as the ice would allow. On October 31 they started, and, passing the site of the winter hut at Mount Bransfield, where they learnt the news of how that party had spent the winter, they arrived at our station just at the last moment when we were going to leave definitely the place and the region.

And now came the last great event in the story of the expedition. After having embarked on the *Uruguay*, the 10th, we passed very early the next morning Paulet Island, awakening its involuntary inhabitants with the steam whistle of our ship. The effect was instantaneous—in a second the beach was alive with men, still unable to understand their luck. The change was too great, after all their privations, with the dark prospect of the future, to be suddenly awakened out of their sleep, placed in the midst of civilization, and at the same time know that all their companions from the two other winter stations were well, and all this to happen so early in the year, when no relief could have been expected.

It was undoubtedly a great proof of the awakened interest of the Argentine nation and of the capacity of its navy to send this expedition, and to us the stay on board has only bright remembrances, for we were received as I believe has rarely been the lot of a shipwrecked expedition. Passing the winter station of Mount Bransfield to pick up the collection left there, we arrived at the port of Santa Cruz on November 22, and during the following hours the telegraph announced to the world the news of our return.

NOTES ON GEOLOGICAL SURVEYS.

WEST VIRGINIA.—Volume I of this survey was issued in 1899, under the direction of J. C. White, State Geologist. It contains records of levels above tide and of the variations of the magnetic compass, but is chiefly devoted to petroleum and natural gas, including the local history of development, the geological relations, and detailed records of many borings. Volume II bears the date 1903, and is chiefly occupied with the coal formations of the State. Incidentally, the author emphasizes the richness in common minerals, soils, and forests of a State which is quite lacking in costly metals. Ten to twelve thousand square miles is given as an estimate of the productive coal territory of West Virginia. The